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GENERAL INTELLIGENCE, MACHINE SHOP WORK, AND EDUCATIONAL GUIDANCE IN THE JUNIOR HIGH SCHOOL

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We may properly assume that recent experiments have established the existence of significantly high correlation between general intelligence, as determined by mental tests, and ability to do the required academic work in our public schools. Can such correspondence be shown to exist between general intelligence and progress in learning to do specific kinds of shop work? In other words, is the boy of low intelligence as much of a misfit in our shop courses as he is in the academic curricula? The question has very great significance if we believe with certain authorities, first, that the largest part of approximately one-third of our elementary-school population which is overage is retarded because of inability to do the required work; second, that of the one-third of our high-school pupils who drop out of school without having completed the work of the first year, a large part drop out on account of inferior mental endowment; third, that at the present time graduation from high school is well beyond the intellectual capacity of a large proportion of the children, for such graduation seems to require a minimum intelligence quotient of 90, while a third of our children test that low or lower. Certainly this one-third of our school population which is evidently not suited for the regular work of our schools is entitled to instruction in subjects which require only such ability as is possessed. Shall these subjects be largely industrial with such related drawing, English, mathematics, science, etc., as can be learned?

This study was undertaken for the purpose of determining within a limited field of shop work the relative chances of success for the boy with a high I.Q. and the one of low-grade intelligence. The specific problem was the determination of the correlation between the intelligence quotients of an unselected group of vocational-class boys, as measured by the Stanford Revision of the Binet-Simon Scale, and their progress in learning the fundamental operations on the engine lathe. The boys in the group, twenty-five in number, were all without previous experience in shop work of any kind except the regular grade-school manual training. In school grades they ranged from low seventh to low ninth. Their chronological ages ranged from fourteen to sixteen years, and their mental ages from ten years and six months to sixteen years and seven months. Their intelligence quotients as determined by the Stanford-Binet Scale ranged from 71 to 111, with an average of 90 for the group. The facts concerning the group are shown in Table I.

The projects included in the course in shop work were ten in number. They were selected and arranged in order upon the basis of the learning difficulties presented. The evaluation of the learning difficulties and the arrangement of the projects were made by an experienced machine-shop instructor. Each project was executed by the student from a blue-print and an instruction sheet. The written instructions were supplemented by oral instructions when necessary. All of the boys completed the projects in the same order. The operations involved in completing the ten projects were centering; plain cylindrical turning, work held between centers; turning to a shoulder; thread cutting; boring, turning, reaming, and facing with work held in chuck; turning between centers on arbor. None of the work required greater accuracy than plus or minus two-thousandths of an inch.

The main difficulties involved were in caring for and manipulating the machine so as not to cause injury to the machine or accident to the operator; regulating the feeds and speeds for the different jobs; advancing tool for proper depth of cut; using scale, micrometer, and inside and outside calipers; adjusting gears for thread cutting; using thread-cutting gauge, backing-belt in thread cutting, and graduated collar on feed screw for depth of cut; reading simple drawings; and making practical applications of fractions and decimals. To win a high score required that the learner be quick in movement; be able to follow simple directions, both written and oral; have a fair sense of touch in the use of gauges and measuring instruments; be able to comprehend a simple blue-print; have such a knowledge of mathematics as would enable him to compute gear ratios and thread proportions; and possess a moderate amount of physical strength.

TABLE I

Chronological Age, Mental Age, and I.Q. of Twenty-five Boys in a Regular Junior High School Class in Engine-Lathe Work

Boys	Chronological Age		Mental Age		I.Q.
	Years	Months	Years	Months	
1	15	0	16	7	111
2	14	0	15	0	107
3	14	5	15	3	106
4	14	0	14	1	101
5	15	4	15	0	98
6	14	11	14	2	95
7	14	11	14	2	95
8	14	5	13	6	94
9	15	11	14	10	94
10	15	2	14	2	93
11	14	8	13	5	92
12	14	3	13	1	92
13	14	5	13	2	92
14	14	8	13	4	91
15	15	4	13	11	91
16	15	3	13	9	91
17	14	11	12	10	87
18	14	8	12	8	86
19	14	1	12	0	85
20	14	4	12	0	84
21	16	0	12	3	77
22	15	1	11	5	76
23	15	3	11	5	75
24	14	8	10	8	73
25	14	8	10	6	71
Median	14	8	13	5	92

The conditions in the shop where the experiment was made were very good. All of the equipment was new. No boys other than those included in the study were in the shop. Not all machines were of the same type, but frequent changes were made from one machine to another in order to offset any advantage which one machine might have over another. The instructor in charge of the shop was a highly skilled mechanic and a graduate of a technical school, with several years' practical experience as well as two and one-half years' teaching experience in the work covered by this instruction group.

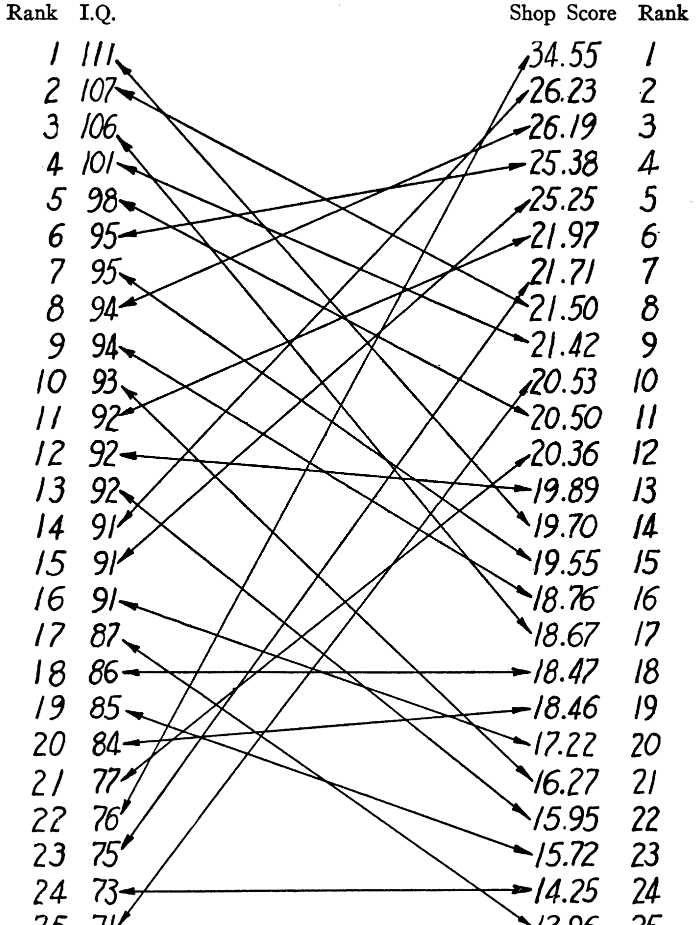

FIG. 1.—Correspondence between I.Q. and shop score of twenty-five junior high school boys.

The boys were scored upon their time cards with a percentage grade which took into account the accuracy and finish of the work as well as the judgment and skill used in manipulating the machine. This score was then divided by the time on the job so that the final grade involved both quality and speed. For example, a boy on Job 1 earned a percentage grade of 90; his time on the job was four and one-half hours; his score, then, was 90 divided by 4.5, or 20. The average of the scores for the ten projects was then taken as the final score for each boy. Figure 1 shows the intelligence quotients and shop scores arranged in order from the highest to the lowest with lines drawn from each boy's intelligence quotient to his shop score. For instance, Case 1 has an I.Q. of 111 or Rank 1 in intelligence. A line is drawn from 111 to 19.70, the pupil's shop score being ranked the fourteenth in the distribution of achievement scores. A glance at the figure with its maze of cross lines reveals the fact that there is very little correlation between the I.Q.'s and the shop scores. As determined by the rank difference method, the coefficient of correlation is + .14, an almost negligible amount of correspondence.

The results indicate clearly that such fairly simple mechanical work can be done successfully by a boy with a rather low I.Q. and that, in general, the boys of low-grade intelligence turn out a better grade of work than the brighter boys. Inasmuch as the work covered in the experiment very fairly represents the type of work usually done in high-school and vocational-school machine shop classes, it is fair to conclude that such classes offer an exceptional opportunity for those who at present are the misfits in the traditional subjects. Furthermore, it is demonstrable that only such ability as is required for success in completing the experimental projects is required for success within a very large range of actual industrial activities. The conclusion must not be drawn, however, that there is no opportunity in the machine trades for men of high intelligence. The finer grades of work in tool- and gauge- and model-making call for abilities which are not demanded in this study.